DOCUMENT RESUME

ED 064 692 24 CS 000 067

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TITLE Some Thoughts About Cognitive Strategies and Reading Comprehension. Theoretical Paper No. 30.
INSTITUTION Wisconsin Univ., Madison. Research and Development Center for Cognitive Learning.
SPONS AGENCY Office of Education (DHEW), Washington, D.C.
BUREAU NO BR-5-0216
PUB DATE Dec 71
CONTRACT OEC-5-10-154
NOTE 15p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Cognitive Processes; *Individual Differences; *Psychological Studies; Reading Ability; *Reading Comprehension; *Reading Research

ABSTRACT

Psychological experiments investigating imposed and induced cognitive strategies are reviewed and related to operations in reading comprehension. It has been suggested that comprehension differences between good and poor readers may arise from the way in which they habitually organize intra- and inter-sentence elements during input. Subject-generated visual imagery is singled out as a particularly effective organizational strategy. Implications of this research are considered in the context of aptitude by treatment interactions and individual differences. (Author)

ED 064692

Theoretical Paper No. 30

SOME THOUGHTS ABOUT COGNITIVE STRATEGIES AND READING COMPREHENSION

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by Joel R. Levin

Report from the Project on Variables and
Processes in Cognitive Learning
Verbal and Visual Components of Children's Learning

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December 1971

Published by the Wisconsin Research and Development Center for Cognitive Learning, supported in part as a research and development center by funds from the United States Office of Education, Department of Health, Education, and Welfare. The opinions expressed herein do not necessarily reflect the position or policy of the Office of Education and no official endorsement by the Office of Education should be inferred.

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Statement of Focus

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Working Paper is from the Project on Variables and Processes in Cognitive Learning in Program 1, Conditions and Processes of Learning. General objectives of the Program are to generate knowledge about concept learning and cognitive skills, to synthesize existing knowledge and develop general taxonomies, models, or theories of cognitive learning, and to utilize the knowledge in the development of curriculum materials and procedures. Contributing to these Program objectives, this project has these objectives: to ascertain the important variables in cognitive learning and to apply relevant knowledge to the development of instructional materials and to the basic processes and abilities involved in concept learning; and to develop a system of individually guided motivation for use in the elementary school.

Acknowledgments

I am grateful to Mrs. Linda Monahan and Miss Terry Fiscus for typing the final draft of the paper.

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Abstract

Psychological experiments investigating imposed and induced cognitive strategies are reviewed and related to operations in reading comprehension. It has been suggested that comprehension differences between good and poor readers may arise from the way in which they habitually organize intra- and inter-sentence elements during input. Subject-generated visual imagery is singled out as a particularly effective organizational strategy. Implications of this research are considered in the context of aptitude by treatment interactions and individual differences.

Introduction

I do not profess to be an expert in reading. Although this sentence is ambiguous, it applies to both my personal reading speed and comprehension, as well as my familiarity with the reading and perception literature in the respective fields of education and psychology. What I would like to do, as an outsider looking in, is to share with you some potential educational applications that grew out of a symposium entitled "Issues in imagery and learning" held at the 1971 Western Psychological Association meeting in San Francisco. The primary focus of the symposium was on visual imagery in children, and its reported positive relationship with learning and memory.

The bulk of the experimentation in which imagery processes have been engaged and inferred (through the use of pictorial and image-evoking materials) has incorporated associative learning tasks in laboratory settings. In a few experiments, comprehension of sentences and sentence-embedded materials has been investigated. A recurring result is that materials which are concrete, imageable, and dynamic are easier to remember than those which are not (e.g., Paivio, 1969; Rohwer, 1967).

A sentence is assumed to make its constituents more memorable by virtue of the organization it bestows on them. It has been hypothesized that the success of the organization depends upon the extent to which increased contextual meaning and imagery is produced (Levin, 1971). A collection of sentences should impose an organization on its constituents in analogous fashion. In this paper, we will restrict our attention to reasonably concrete materials. That is, sentences like "Continuous fraud negates implied sincerity" are probably less concrete and imageable than sentences like "Giddy spinsters terrify squealing infants" (Davidson, 1966). Paivio (1970) has presented data which support this notion, by showing that the former type of sentence is accompanied by longer imagery latencies (i.e., a greater amount of time is required to form a mental image of the sentence's contents), as well as by inferior recall of the general meaning of the sentence (though not necessarily the individual words).

Consider the school-age child who cannot comprehend—and consequently will not remember—the content of what he reads. I am not referring to the child who cannot identify (decode) the words, although the ensuing discussion may in fact be relevant when considering this type of reading disability as well.[1] Neither am I referring to the child who can identify the words correctly, but cannot derive meaning from them because they are foreign to his experiential vocabulary (see Wiener & Cromer, 1967). For now, I will focus my attention on the child who can identify the words, knows the meaning of individual words, but has difficulty in integrating the separate meanings into an organized whole. The child to whom I am referring possesses average or above average decoding and vocabulary skills, but exhibits poor performance on tasks which involve reading comprehension.

Wiener and Cromer (1967) have considered this type of reading disability in what they have called a "difference" model. Unlike the traditional view that all reading problems result from either disorders (generally organic) or deficits (lack of prerequisite identification and/or vocabulary skills), these authors have argued that at least two other models of reading difficulty need to be considered: the "disruption" model, where emotional and psychological barriers which are interfering with the reading process must be removed; and the "difference" model.

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[1]Personal communication from Dr. Roger A. Severson, Associate Professor of Educational Psychology, University of Wisconsin, February 1971.

The "difference" model asserts that:

> ...reading difficulty is attributable to *differences* or mismatches between the typical mode of responding and that which is more appropriate, and thus has the best payoff in a particular situation. This model assumes that the individual would read adequately if the material were consistent with his behavior patterns; thus, a *change* in either the material or in his patterns of verbalization is a prerequisite for better reading. [Wiener & Cromer, 1967, p. 629]

Take another look at the last sentence. What this is saying is that a "difference" between good and poor readers is attributable to the way in which they respectively input what they read. Good readers typically comprehend; poor readers do not. In order for poor readers to perform more like good readers, one of two events must occur: (a) the reading materials must be changed in some way (e.g., their content, their structure, their representational mode, and the like); or (b) poor readers must learn (be taught) to employ some of the successful responding "habits" of good readers. It is interesting that the same two recommendations have been made elsewhere, with regard to making the performance of children who are poor learners more like that of children who are good learners (e.g., Levin, Rohwer, & Cleary, 1971; Rohwer, 1970).

At the imagery and learning symposium, I recommended that a distinction be made between two different approaches to the study of facilitative variables in children's learning (Levin, 1971). One line of research has typically dealt with manipulations of learning materials which render them more or less memorable. Specifically, verbal and imaginal representations *imposed* on subjects by experimenters have been shown to affect performance on learning tasks. Rohwer's (1967) extensive investigation of semantic and syntactic aspects of verbal "elaboration" and Paivio's (1969) manipulation of the concreteness-image evocativeness of learning materials exemplify the "imposed" paradigms to which I refer. The variations in characteristics of prose materials by Frase and his associates (e.g., Frase, 1969; Frase & Washington, 1970; Maroon, Washington, & Frase, 1971) are of particular relevance here.

A second class of experiments has examined the effect of prelearning instructions, usually in the form of a strategy or mnemonic, which are *induced* in subjects by experimenters. A technique is introduced by the experimenter which, if adopted by the subject, likely will facilitate the ensuing task. The comparative effectiveness of various strategies (notably those requiring subject-generated verbalization and imagery) has been studied, summaries of which may be found in the reports of Bower (1971) and Levin (1971).

In the remainder of this paper, I will distinguish between the imposed and induced methodologies which, in fact, I have already done vis-à-vis the Wiener and Cromer (1967) quote. The reader will be helped in making this distinction through the use of appropriate section headings, examples, and explicit references.

Imposed Characteristics and Reading Comprehension

Cromer (1970) wanted to see if changes in the structure (i.e., organization) of reading materials would benefit subjects who had the necessary identification and vocabulary skills, but who exhibited poor comprehension. As a partial validation of the reading difficulty models mentioned previously, Cromer selected samples of poor-reading junior college students with either "deficit" or "difference" problems. The two groups of poor readers were comparable in mean IQ (Deficit: 110.4; Difference: 111.3), but the Deficit group's mean vocabulary score (154.4) was lower than that of the Difference group (158.9). The mean vocabulary score of the Difference group corresponded to the median score for college freshmen.

Subjects read stories in which the sentences were "organized" in various ways. In two of the conditions, the sentences appeared either in regular form, e.g.:

"The cow jumped over the moon"

or in predetermined phrase groupings, e.g.:

"The cow jumped over the moon"

The latter groupings were based on agreed-upon phrase boundaries as prescribed by Lefevre (1964).

The basic finding of the Cromer (1970) study was that when the story was presented in regular sentence form, there were large differences in comprehension between the poor-reading groups and matched (in IQ) groups of good readers. However, when the phrase groupings were employed, the performance of the Difference poor readers was as high as

that of the good readers. The Deficit group's performance remained low, in accordance with the reading difficulty models. That is, a different organization of the materials would be expected to help only those subjects who read poorly for reasons other than identification and/or vocabulary deficits.

Changing the organization of printed materials is a technique which was found to facilitate the performance of poor readers (Cromer, 1970). Another question which may be asked is whether poor readers comprehend story passages better when they are presented in alternative modes (e.g., in auditory or pictorial, as opposed to printed, form). In a study by Oakan, Wiener, and Cromer (1971), for example, it was found that poor readers comprehended slightly more when they *listened* to stories than when they *read* them themselves. For good readers, the reverse was true.

Matz and Rohwer (1971) used two groups of subjects, one from a white middle-class population and the other from a black lower-class population. The two groups differed substantially in IQ and (presumably) in reading achievement. Story passages were read to subjects in the company of either regular printed sentences or line drawings which appeared in sequence as each sentence of the story was read. For the better readers (middle-class whites), it didn't make much of a difference whether a printed or pictorial accompaniment of the story was employed. Performance was good under both conditions. For the poorer readers (lower-class blacks), when the story was accompanied by printed sentences, performance was very poor; when pictorial representations were used, performance was as good as that of the better readers. Saying that these children cannot comprehend *written* stories is quite different from saying that they cannot comprehend stories.

The same type of argument is used by Jensen (1969) in his discussion of the differing correlations between Level I and Level II abilities in middle-and lower-class populations. The correlation between IQ (a Level II measure) and learning ability (a Level I measure) is hypothesized to be quite strong for middle-class children and quite weak for lower-class children. An implication of this is that middle-class children with low IQs probably are slow learners as well; the same statement cannot be made with confidence for lower-class children with low IQs, however.

The results of both the Cromer (1970) and the Matz and Rohwer (1971) studies may be represented by the all-purpose model in Figure 1. When learning or comprehension is assessed on the basis of a single method or manipulation, only the subjects from Population I will demonstrate mastery. When a different method or manipulation is imposed, the mean performance difference between the two populations virtually disappears.

This, of course, gets at the heart of the aptitude-treatment interaction (ATI) debates, the one difference here being that Method B is better than Method A for *both* populations, but comparatively less so for subjects in Population I. Till now, the ATI'ers have been concerned mainly with the detection of disordinal (cross-over) interactions, such that Method A works best for Population I and Method B works best for Population II. This type of ATI has not been easy to demonstrate, however (Bracht, 1970; Cronbach & Snow, 1969). Neither have aptitudes and treatments in the context of task and ecological variations been seriously considered (Levin, 1971; Salomon, 1971).

An ATI stance is certainly applicable to the ordinal interaction model portrayed in Figure 1. It simply says that variations in the nature of instructional materials are not as crucial for "good" students as they are for "poor" students. This should not imply that variations in the quality of the organization or mode of the materials will have *no* effect on the performance of good students [see, for example, Maroon et al., 1971]. In the Oakan et al. (1971) experiment already cited, good readers comprehended substantially less when they read stories which were transcriptions of poor readers' efforts to read the normal passage. These transcribed stories included "...all of the poor reader's pauses, false starts, errors, mispronunciations, omissions, etc." Furthermore, as noted earlier, when the good readers were tested for comprehension after *listening* to stories read to them, their performance was worse than when they read the stories themselves.

An explanation provided by the authors is that in reading the passages themselves, good readers are able to go back and re-read any misunderstood parts of the sentence which, of course, is not possible when listening to a single spoken version of the same story. It is also probable that when good readers read, they are employing well-developed organizational strategies which are conducive to comprehension, and as the authors suggest:

> ...if poor readers typically do not organize their input into certain efficacious patterns, they may have considerable difficulty understanding what they read ....(Oakan et al., 1971, p. 77)

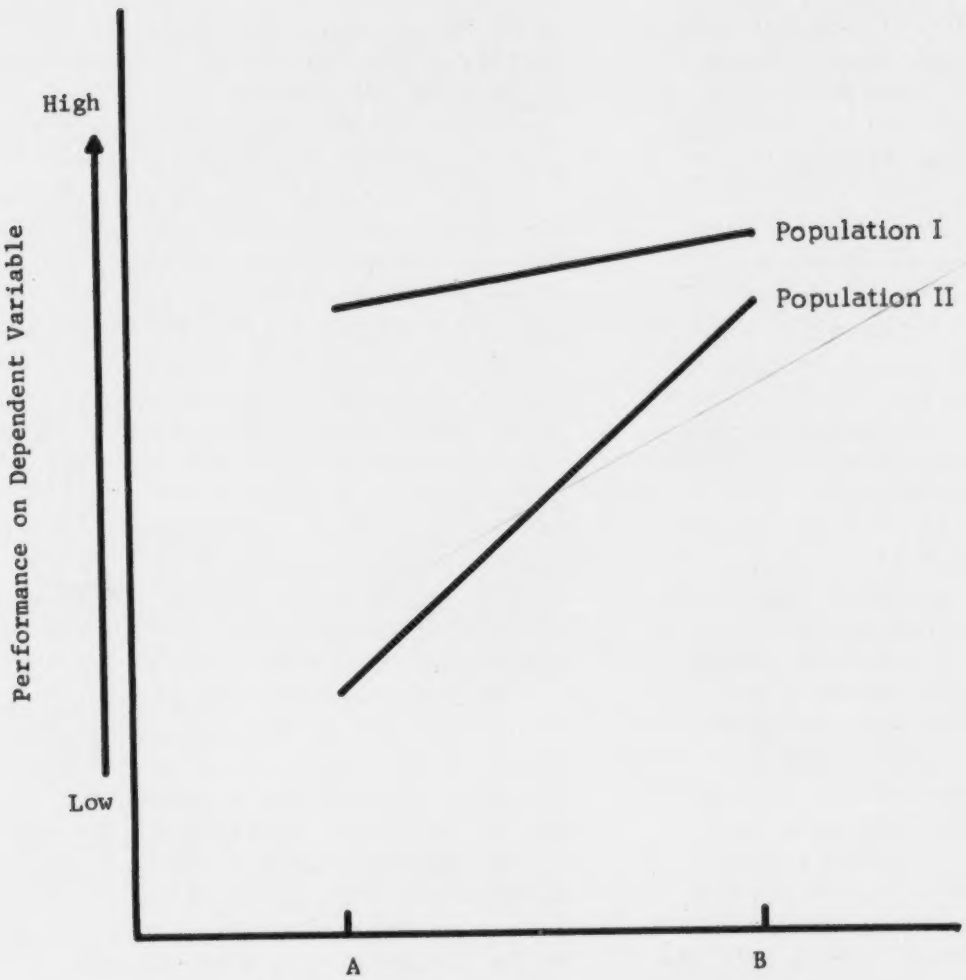

Figure 1. Hypothesized Ordinal Interaction Between Aptitude (Population) and Treatment (Imposed Independent Variable) to Account for Some Recent Findings

There are two major recommendations which follow from the ordinal ATI model in Figure 1. The first of these is that it is incumbent upon us to find the optimal presentations of learning materials for children who appear to be slow learners. Given a sufficient variety of presentations, many children tabbed as "nonlearners" will emerge as "learners." At the same time, others will not. It is only this latter group whom we may legitimately regard as "nonlearners" and who will require greater remediation than merely changes in materials.

Matz and Rohwer (1971) have demonstrated that children from middle and lower social class groups differ only slightly in comprehension when pictures accompany an auditory version of a story. We have just completed a similar study with fourth graders which suggests that good and poor readers from the *same* social class differ less (in terms of comprehension) when a pictorial representation of text is used in place of the text itself.

If both good and poor readers can comprehend stories based on pictorial representations, then it is reasonable to ask whether good readers are doing something pictorial-like when they are reading regular printed materials, while poor readers are not. This brings us to the second (and potentially more important) recommendation indicated by the model in Figure 1.

Induced Characteristics and Reading Comprehension

Notice that until now we have been discussing changes in learning materials which improve the performance of poor readers. That is, we have considered *imposed* characteristics

of reading materials. Our attention will now be directed toward presumed differences in the usual reading habits of good and poor readers. If certain of these can be identified, then it might prove fruitful to instruct or *induce* poor readers to employ the habits of good readers when less than "optimally structured" reading materials are presented. (Note that for school- and real world-related reading activities, this will generally be the rule rather than the exception.)

Just what might some of the habits of good readers be? Certainly those which contain facilitating structures. That self-generated visual imagery is an established tactic of proficient readers has been first mildly, and then strongly, suggested in a pair of recent studies by Richard Anderson and his associates at the University of Illinois.

The first experiment (Anderson & Hidde, 1971) extends some recent findings dealing with sentence comprehension. Bobrow and Bower (1969), for example, found that subjects who were asked either to "disambiguate" (determine the contextual meaning of a multiple-meaning word) or to "continue" (construct a logical consequence of a provided sentence) a list of sentences, exhibited recall superior to subjects who were asked to peruse the same sentences for spelling errors. Similarly, Begg and Paivio (1969) reported that subjects were better able to detect semantic changes—as opposed to lexical changes which had little effect on meaning—in a repeated list of sentences, especially when the materials were relatively concrete. The importance of "meaning" in comprehension has been demonstrated in these and similar experiments (e.g., Bobrow, 1970; Levin & Horvitz, 1971). By the same token, the role of "imagery" cannot be discounted.

In the Anderson and Hidde (1971) study, college students were asked to rate either the pronunciability or imagery vividness of 30 sentences. On a surprise test for recall of as many sentences as the subject could remember, it was found that the imagery-rating group recalled far more sentences and sentence parts (e.g., verbs and objects) than did the pronunciability-rating group.

This is interesting in light of the fact that subjects in the latter group actually read each sentence aloud (three times) in rating its pronunciability while those in the former group did not. On the other hand, this kind of sentence rehearsal may have been interfering (rather than imagery being facilitative), as has been shown to be the case in intentional learning paradigms with older subjects (e.g., Bean & Rohwer, 1971; Bobrow & Bower, 1969). Within the imagery-rating group, a moderate relationship was found between subjects' reported vividness of a sentence's imagery and its probability of being recalled.

Anderson's second study provides more direct evidence for the imagery-reading comprehension hypothesis. In that experiment (Anderson & Kulhavy, 1971), high school seniors were given a written passage to read either with or without instructions to visualize what they were reading. Although the experimental manipulation (i.e., instructions to use imagery) was not effective in a "main effect" sense, a pronounced relationship was found between subjects' reported frequency of imagery throughout the passage and amount of information recalled about it (independently of their instructional conditions). Thus, those subjects who reported having used imagery extensively recalled more of what they read than those who reported having used little or no imagery.

In our previously mentioned study with fourth graders, we manipulated the degree to which subjects presumed to be non-imagery producers (poor readers) generated visual images while reading, by inducing imagery in them or not. As predicted, the imagery strategy improved comprehension, and in accordance with the Wiener and Cromer (1967) models, "difference" poor readers (those with adequate vocabulary skills) benefitted more than "deficit" poor readers (those lacking prerequisite vocabulary skills). The interpretation of such results is similar to Cromer's (1970) and, of course, has important implications with regard to the teaching of reading to children who read poorly for diverse reasons. The training of imagery production in children in need of an organizational framework looms as a reasonable strategy.

Much of what I have been saying has been thought, if not articulated, by others before (including reading experts). It is especially noteworthy that in one of the standard reading tests, among the authors' suggestions for improving the reading of low achievers may be found:

> Word recognition practice, phrase practice and expression practice should require response to meaning and imagery. Reading is getting ideas from the printed word; all aspects of reading instruction should focus upon meanings and reactions to meanings. (Durrell & Hayes, 1969; Durrell & Brassard, 1969)

These comments appear on the primary (Grades 1–3.5) and intermediate (Grades 3.5–6) versions of the Durrell test, and are apparently intended for "deficit" poor readers. However, a generalization of the imagery idea from comprehension of words to comprehension of sentences and paragraphs is not included in Durrell's (1969) suggestions on the advanced (Grades 7-9) version of his test, where a greater proportion of poor readers are probably of the "difference" variety.

As educators, we should continually be seeking ways in which the learning process may be improved and hopefully be made more enjoyable. Changing characteristics of existing materials or changing students' characteristic learning behaviors seem to be two reasonable (and not necessarily mutually exclusive) possibilities. While the "imposed" approach caters to individual and group differences through the presentation of differentially effective organizations, the "induced" approach promises the greater educational payoff beyond the confines of the well-organized textbook, the optimally sequenced teaching machine, and the multitalented teacher. Equipped with efficient induced strategies, the child will be less dependent on the quality of stimuli in his environment, for he will be capable of reorganizing, elaborating, and concretizing relatively disorganized, unelaborated, and abstract materials. Of course, to anticipate this without regard to the auxiliary efforts required (for example, shaping such behaviors over time with the help of appropriate reinforcers) is beyond comprehension.

References

Anderson, R. C., & Hidde, J. L. Imagery and sentence learning. *Journal of Educational Psychology*, 1971, 62, 526-530.

Anderson, R. C., & Kulhavy, R. W. Imagery and prose learning. Unpublished manuscript, University of Illinois, 1971.

Bean, J. P., & Rohwer, W. D., Jr. Noun pair learning in adolescents: Population differences. Paper presented at the annual meeting of the American Educational Research Association, New York, February 1971.

Begg, I., & Paivio, A. Concreteness and imagery in sentence meaning. *Journal of Verbal Learning and Verbal Behavior*, 1969, *8*, 821-827.

Bobrow, S. A. Memory for words in sentences. *Journal of Verbal Learning and Verbal Behavior*, 1970, *9*, 363-372.

Bobrow, S. A., & Bower, G. H. Comprehension and recall of sentences. *Journal of Experimental Psychology*, 1969, *80*, 455-461.

Bower, G. H. Mental imagery and associative learning. In L. Gregg (Ed.), *Cognition in Learning and Memory*. New York: John Wiley & Sons, 1971.

Bracht, G. H. Experimental factors related to aptitude-treatment interactions. *Review of Educational Research*, 1970, *40*, 627-645.

Cromer, W. The difference model: A new explanation for some reading difficulties. *Journal of Educational Psychology*, 1970, *61*, 471-483.

Cronbach, L. J., & Snow, R. E. Individual differences in learning ability as a function of instructional variables. Final report, USOE, Contract No. OEC-4-6-061269-1217, March 1969.

Davidson, R. E. Semi-grammaticalness in the free learning of sentences. Unpublished doctoral dissertation, University of California, Berkeley, 1966.

Durrell, D. D. *Durrell Listening-Reading Series, Advanced Level*. New York: Harcourt, Brace & World, 1969.

Durrell, D. D., & Brassard, M. B. *Durrell Listening-Reading Series, Intermediate Level*. New York: Harcourt, Brace & World, 1969.

Durrell, D. D., & Hayes, M. T. *Durrell Listening-Reading Series, Primary Level*. New York: Harcourt, Brace & World, 1969.

Frase, L. T. Paragraph organization of written materials: The influence of conceptual clustering upon the level and organization of recall. *Journal of Educational Psychology*, 1969, *60*, 394-401.

Frase, L. T., & Washington, E. D. Children's ability to comprehend text. Paper presented at the annual meeting of the American Psychological Association, Miami, September 1970.

Jensen, A. R. How much can we boost IQ and scholastic achievement? *Harvard Educational Review*, 1969, *39*, 1-123.

Lefevre, C. A. *Linguistics and the Teaching of Reading*. New York: McGraw-Hill, 1964.

Levin, J. R. Issues in imagery and learning: Verbal and visual variables. Symposium paper presented at the annual meeting of the Western Psychological Association, San Francisco, April 1971.

Levin, J. R., & Horvitz, J. M. The meaning of paired associates. *Journal of Educational Psychology*, 1971, *62*, 209-214.

Levin, J. R., Rohwer, W. D., Jr., & Cleary, T. A. Individual differences in the learning of verbally and pictorially presented paired associates. *American Educational Research Journal*, 1971, *8*, 11-26.

Maroon, S., Washington, E. D., & Frase, L. T. Text organization and its relationship to children's comprehension. Paper presented at the annual meeting of the

American Educational Research Association, New York, March 1971.

Matz, R., & Rohwer, W. D., Jr. Visual elaboration of text. Paper presented at the annual meeting of the American Educational Research Association, New York, March 1971.

Oakan, R., Wiener, M., & Cromer, W. Identification, organization, and reading comprehension for good and poor readers. *Journal of Educational Psychology*, 1971, *62*, 71-78.

Paivio, A. Mental imagery in associative learning and memory. *Psychological Review*, 1969, *76*, 241-263.

Paivio, A. Imagery and language. Research Bulletin No. 167, University of Western Ontario, 1970.

Rohwer, W. D., Jr. Social class differences in the role of linguistic structures in paired-associate learning: Elaboration and learning proficiency. Final report, USOE, Contract No. OE 6-10-273, November 1967.

Rohwer, W. D., Jr. Images and pictures in children's learning: Research results and educational implications. *Psychological Bulletin*, 1970, *73*, 393-403.

Salomon, G. Aptitude-treatment interactions. Colloquium held at the annual meeting of the American Educational Research Association, New York, March 1971.

Wiener, M., & Cromer, W. Reading and reading difficulty: A conceptual analysis. *Harvard Educational Review*, 1967, *37*, 620-643.

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